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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/160,965	09/25/1998	SHAU-LIN SHUE	TSMC97-542/9	6951

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EXAMINER
KIELIN, ERIK J

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2813	18

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/160,965	Applicant(s) Shue et al.
	Examiner Erik Kielin	Art Unit 2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Jan 24, 2002*.

2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1, 2, 4, 6, and 10-12* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1, 2, 4, 6, and 10-12* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☒ The proposed drawing correction filed on *Jan 24, 2002* is: a) ☐ approved b) ☒ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☐ Notice of References Cited (PTO-892)
16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
18) ☐ Interview Summary (PTO-413) Paper No(s). _____
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other:

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "cap layer" of independent claim 1 must be shown must be shown or the feature(s) canceled from the claim(s). **No new matter should be entered.**

2. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 1/24/02 have been disapproved because they introduce new matter into the drawings. 37 CFR 1.121(a)(6) states that no amendment may introduce new matter into the disclosure of an application. The original disclosure does not support the showing of the capping layer over the entire surface of the substrate. The specification indicates that the copper damascene is capped -- not the whole of the substrate.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-2, and 4, 6, 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Lin** (US 6,093,656) in view of **Rathore** et al. (US 6,069,068) and **Datta** et al. (US 5,567,300)

Lin discloses the silicon substrate 12, the damascene trenches 13, 14 in a dielectric layer, the barrier metal layer (column 3, lines 17-23); the copper layer 20 (or "conductor," claim 1); the reverse tone photoresist mask 26 which covers the copper in the trenches (column 3, lines 32-57; Fig. 3); etching the exposed copper portions down to the silicon using a wet etch (Fig. 4; column 4, lines 15-21); stripping the photoresist (column 4, lines 22-25); planarizing the copper by CMP (column 4, lines 27-29). See also columns 1-4 and all figures.

Lin does not (1) specifically use the terminology, "dual damascene" or show a dual damascene structure in the figures, (2) does not specifically state that the disclosed "blanket copper deposition" (column 3, line 24) is electroplating on a seed layer; (3) reverse current electroplating; or (4) the cap layer.

Regarding (1), aside from it being known in the art that dual damascene (as opposed to single damascene) is also subject to dishing during metal planarization and for the same reasons , **Lin**'s claim 1 indicates the damascene, dielectric trenches have "at least two levels of elevation." A third level of elevation would clearly yield a dual damascene trench structure. Therefore, **Lin** implicitly defines the invention for dual damascene. Note that it has been held that "[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be

expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976). Therefore, dual damascene is at least implicitly disclosed as being incorporated both in Lin's inclusive claim language and in that fact that dual damascene is notoriously well known in the art, especially as defined in the Lin claims.

Regarding (2) and (4), although **Lin** does not specifically state electroplating is used for filling, **Lin** does teach that the blanket deposition of copper "could be done in a number of different ways..." (column 3, lines 23-27). **Rathore** teaches that it is known in the art to fill a dual damascene pattern using electroplating of copper on the stack consisting of adhesive layer 5, barrier layer 6, and seed layer 8 followed by planarization of the electroplated copper layer 9 and said stack (column 2, lines 45-59; Fig. 1a) and finally depositing a cap layer 7, 10 to seal the copper. (See Figs. 6b-6d.) Note also the **Rathore** states that "electroplating of copper **requires** a copper seed layer" (column 2, lines 3-5; emphasis added).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any conventional copper electroplating on a required seed layer for the reason given in **Lin** because **Lin** teaches blanket depositing which clearly indicates to one of ordinary skill that **any** blanket depositing method is appropriate, such as the electroplating of **Rathore**.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the cap layer for the reasons indicated in **Rathore**.

Regarding (3), **Datta** et al. and references cited therein teaches the benefits of reverse current electroplating for the purpose of removing unwanted metal -- particularly copper -- regions for the purpose of planarizing (sections entitled "Planarization is desirable for two reasons" and "There are various planarization methods ").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify **Lin** in view of **Datta** for the reasons given in **Datta**.

Regarding claim 4, in claim 1 of **Lin**, the layer 20 is limited to only "conductors" and therefore makes the use of any of Applicant's claimed conductors obvious. It has been held that selection of a known material based on its suitability for its intended use is *prima facie* obvious.

Regarding claim 6, **Lin** does not indicate that the dielectric is silicon oxide, but it is known to use silicon oxide for the dielectric in damascene processes and is therefore obvious to one of ordinary skill to use as a matter of routine material choice. See *Sinclair & Carroll Co., Inc. v. Interchemical Corp.* , 325 U.S. 327, 65 USPQ 297 1945). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960). The choice of silicon oxide for Lin's dielectric; Au, Al, with, Ti, or Ag for Lin's conductor; and are obvious as amounting obvious material choice, well within the purview of those of ordinary skill, as per the precedent above.

Regarding claims 11-12, Lin makes clear the inherency of or alternatively suggests Applicant's "critical dimensions" in Lin's discussion of the reverse tone photoresist mask. The choice of critical dimensions is obvious as a matter of routine optimization. These claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative

to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Response to Arguments

5. Applicant's arguments filed 1/24/02 have been fully considered but they are not persuasive.

Applicant argues, in quoting the passage quoted in Lin by Examiner in the rejection above, that the Lin statement "that the blanket deposition of copper 'could be done in a number of different ways...' in no way teaches anything." Examiner expressly disagrees. It specifically tells those of ordinary skill in the art the "a number of different ways" are appropriate for deposition of copper which implicitly means any art known method such as the notoriously well known electroplating. Applicant's argument is quite simply without merit.

Applicant continues arguing in this regard that "It appears to Applicant that Lin is then teaching away because nobody after Lin could then suggest any other way of blanket deposition of copper." Again, Examiner expressly disagrees. This assertion directly contradicts the express statement in Lin that the blanket deposition of copper "could be done in a number of different ways." How then could this "teach[] away" form the use of other methods? Applicant's argument not only blatantly ignores the express teaching of Lin, but defies common sense in its assertion. This argument is wholly without merit.

Applicant's argument that Rathore "strictly addresses the filling and planarization of copper interconnections." Rathore was provided at least to show such copper filling and planarization making its combination with Lin who discloses **global** planarization of interconnections appropriate. Accordingly, Applicant's argument in this regard is moot.

Applicant does not appear to provide an argument regarding the cap layer. The cap layer provided in the proposed drawing corrections introduces new matter. The capping layer in no way affects the planarization anyway because it occurs after the planarization and can therefore not have any causal impact. The cause necessarily precedes the effect. Nonetheless, Rathore teaches the capping layer, making any argument in this regard moot. Examiner, accordingly, disagrees that there is anything unique about the instant invention.

Regarding Applicant's statement "that Datta et al. teaches reverse electroplating and its benefits, including various planarization methods" Examiner agrees that this is what Datta teaches and why one of ordinary skill would be motived to apply the teachings therein to copper damascene planarization. Examiner disagrees that Applicant has provided any improvement not already taught and suggested by the applied art.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Fiordalice et al., US 5,578,523, at column 1, line 59 to column 2, line 27, teaches that the causes of dishing in single damascene are the same as those in dual damascene.

Bernhardt et al. (US 5,256,565) teaches reverse current electroplating to planaraize damascene copper electroplated onto a seed layer.

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703) 306-2794 or by e-mail at olik.chaudhuri@uspto.gov. The fax phone number for the group is (703) 308-7722 or -7724. 7724.

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February 16, 2002

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